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### Semester One Examination, 2019

### Question/Answer booklet

# MATHEMATICS

If required by your examination administrator, please place your student identification label in this box

**SPECIALIST**

**UNIT 1**

## Section Two:

## Calculator-assumed

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Student number: In figures |  |  |  |  |  |  |  |  |  |  |

In words

Your name

## Time allowed for this section

Reading time before commencing work: ten minutes

Working time: one hundred minutes

## Materials required/recommended for this section

***To be provided by the supervisor***

This Question/Answer booklet

Formula sheet (retained from Section One)

***To be provided by the candidate***

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,  
correction fluid/tape, eraser, ruler, highlighters

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators approved for use in this examination

## Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

## Structure of this paper

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | Working  time (minutes) | Marks available | Percentage of examination |
| Section One:  Calculator-free | 8 | 8 | 50 | 52 | 35 |
| Section Two:  Calculator-assumed | 13 | 13 | 100 | 98 | 65 |
|  | | |  | **Total** | 100 |

|  |  |  |
| --- | --- | --- |
| Markers use only | | |
| Question | Maximum | Mark |
| 9 | 5 |  |
| 10 | 8 |  |
| 11 | 7 |  |
| 12 | 8 |  |
| 13 | 8 |  |
| 14 | 9 |  |
| 15 | 8 |  |
| 16 | 7 |  |
| 17 | 8 |  |
| 18 | 8 |  |
| 19 | 7 |  |
| 20 | 7 |  |
| 21 | 8 |  |
| S2 Total | 98 |  |
| S2 Wt (×0.6633) | 65% |  |

## Instructions to candidates

1. The rules for the conduct of examinations are detailed in the school handbook. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen.  
Do not use erasable or gel pens.

3. You must be careful to confine your answer to the specific question asked and to follow any instructions that are specified to a particular question.

4. Show all your working clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.

5. It is recommended that you do not use pencil, except in diagrams.

6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

7. The Formula sheet is not to be handed in with your Question/Answer booklet.

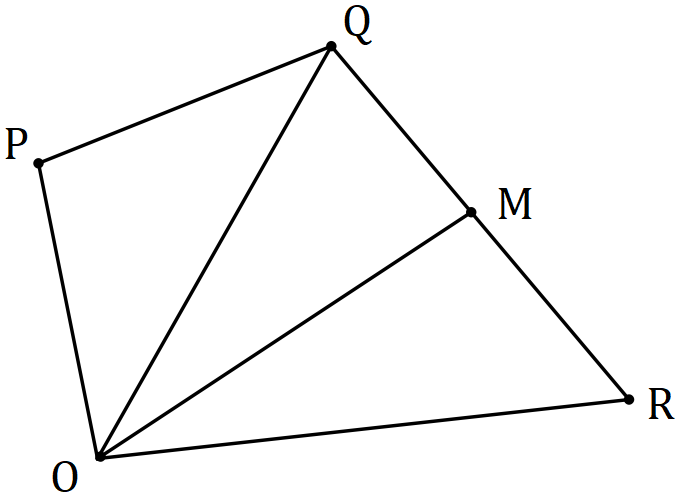
Section Two: Calculator-assumed 65% (98 Marks)

This section has**thirteen (****13)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 100 minutes.

Question 9 (5 marks)

In the diagram below, is the midpoint of .



If and , express the following in terms of and .

(a) . (1 mark)

(b) . (2 marks)

(c) . (2 marks)

Question 10 (8 marks)

Points and have coordinates and respectively. Determine

(a) . (1 mark)

(b) . (2 marks)

(c) , where is a unit vector in the direction . (3 marks)

(d) the coordinates of point , given that . (2 marks)

Question 11 (7 marks)

Three vectors are given by , and , where is a constant.

(a) Determine the vector projection of on . (3 marks)

(b) Determine the value(s) of if and are perpendicular. (2 marks)

(c) Use your calculator to determine the angle between , to the nearest degree.

(2 marks)

Question 12 (8 marks)

(a) Show that the vectors and are perpendicular. (2 marks)

(b) Determine, to the nearest degree, the angle between the vectors and .

(2 marks)

(c) The vectors and are perpendicular, where is a constant. Determine the value(s) of and the corresponding pair(s) of vectors. (4 marks)

Question 13 (8 marks)

(a) Two vectors are and .

(i) State the magnitude of and the angle it makes with the positive -axis. (2 marks)

(ii) Show that the vectors and are parallel. (2 marks)

(b) The points with position vectors and are collinear, where and are constants. Express in terms of . (4 marks)

Question 14 (9 marks)

The parts of this question refer to the word AERIFICATION. It has different consonants and vowels, some of which are repeated.

(a) Determine the number of ways that different consonants chosen from the letters of the word can be arranged in a row. (1 mark)

(b) Determine the number of ways that all the letters of the word can be arranged in a row.

(2 marks)

(c) Determine the number of ways that all the letters of the word can be arranged in a row if the vowels must all be adjacent. (3 marks)

(d) Determine how many letter permutations (e.g. TFI, IRI, etc) can be made using the letters of the word. (3 marks)

Question 15 (8 marks)

(a) 8-character passwords can be created using both lower or upper case letters as well as digits.

Write an expression that would give the total number of 8-character passwords that start with a digit and end with a consonant, and characters are not repeated.

You must use the notation and/or within your expression. Do not evaluate it.

(3 marks)

(b) Prove that: (5 marks)

Question 16 (7 marks)

Three forces and act on a point in a plane.

The forces are, N and .

(a) Determine the magnitude of the resultant force and the direction, to the nearest degree, that the resultant makes with the vector . (3 marks)

When , the forces are in equilibrium.

(b) Determine the values of the scalar constants and for equilibrium to occur. (4 marks)

Question 17 (8 marks)

(a) A set of cards is numbered from to . Determine the minimum number of cards that must be selected to ensure that at least cards in the selection have the same last digit. Justify your answer using the pigeonhole principle. (3 marks)

(b) Eight different books sit on a shelf, one of which has a hardcover and the rest softcovers. A student is told they can take away as many of them as they like but must not leave empty handed. Determine how many different selections can be made

(i) of exactly books. (1 mark)

(ii) altogether. (2 marks)

(iii) that include the hardcover. (2 marks)

Question 18 (8 marks)

Relative to the origin, and have position vectors and respectively.

Particle is initially at and moves with a constant velocity of ms-1.

(a) Calculate

(i) the speed of . (1 mark)

(ii) the position vector of after seconds. (1 mark)

(iii) the distance of from after seconds. (2 marks)

(b) Determine how long after leaving that is m from . (4 marks)

Question 19 (7 marks)

is a trapezium with parallel and in the same direction to .

(a) Sketch a labelled diagram of . (1 mark)

(b) Show that . (2 marks)

(c) lies on and lies on so that . Use a vector method to prove that is a trapezium. (4 marks)

Question 20 (7 marks)

Farm lies km away from farm on a bearing of . A helicopter leaves farm at am to fly to farm . The helicopter can maintain a speed of kmh-1 and there is a steady wind of kmh-1 blowing from the north.

Determine the bearing that the helicopter should steer and the time of its arrival at farm , to the nearest minute.

Question 21 (8 marks)

Determine how many of the integers between and inclusive are

(a) divisible by . (1 mark)

(b) divisible by or . (3 marks)

(c) divisible by or but not both. (1 mark)

(d) divisible by or but not . (3 marks)

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

Supplementary page

Question number: \_\_\_\_\_\_\_\_\_

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